State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: ALL DISTRICT DIRECTORS
ATTENTION: ALL PROJECT MANAGERS
ALL ENCROACHMENT PERMIT ENGINEERS
CHIEF, DIVISION OF ENGINEERING SERVICES
ALL HOLDERS OF THE HIGHWAY DESIGN MANUAL
ALL HOLDERS OF THE TRAFFIC MANUAL

Date: July 15, 2003

From: DOLORES VALLS
Acting Chief
Division of Design

Subject: Revised Design Information Bulletin 79 – RRR and Safety Design Criteria

This transmittal memorandum provides notice that the above referenced revised Design Information Bulletin (DIB) is now available on the Division of Design website (http://www.dot.ca.gov/hq/oppd/dib/dibprg.htm). This updated version of DIB 79 shall be referred to as DIB 79-02 and is effective as of July 10, 2003.

PURPOSE

DIB 79-02 provides geometric and safety upgrade design criteria for resurfacing, restoration, and rehabilitation (RRR) projects on the State highway system. These design criteria also apply to certain safety, protective betterment, operational improvement and storm damage projects. In addition, DIB 79-02 consolidates RRR design and traffic operations information.

BACKGROUND

Federal regulations were revised on June 4, 1982 to allow each state the opportunity to adopt geometric design criteria for nonfreeway RRR projects, in lieu of new construction standards. Caltrans took advantage of this opportunity in 1983 to develop and adopt geometric design criteria for nonfreeway RRR projects. DIB 79-02 is the most recent update of these criteria.

IMPLEMENTATION

Effective July 10, 2003, all applicable projects shall conform to the guidance presented in DIB 79-02. Projects, where project development efforts have started, shall comply with HDM Index 82.5 (Effective Date for Implementing Design Revisions to Design Standards).

DIB 79-02 supersedes DIB 79-01.

Changes over the past years have precipitated the need for revised standards and guidance to Caltrans DIB 79. DIB 79-01, which was released September 2001, updated Section 100 regarding the "Application of RRR Standards." This new version, termed DIB 79-02, makes numerous revisions to standards and guidance throughout the document. The following list summarizes the major changes and concepts:

- Rewording to clarify the definition and application of RRR criteria.
- Added guidance related to safety and good design practices.
- Updated references.
- Updated criteria and language to accommodate current policy issues such as Maintenance, ADA, pedestrian and bicycle traffic, Clear Recovery Zone, Storm Water Pollution, and Rumble Strips.
- Some RRR criteria have been lowered to less stringent requirements than found in the current HDM, such as slope steepness less than 1:4 and catch points less than 5.5 meters.
- Some standards have been modified to be consistent with the HDM, such as shoulder cross slopes.
- A new mandatory standard has been added requiring shoulder widening when replacing bridge rail. The mandatory standard for minimum in-place shoulder widths for 3001 – 6000 ADT has been increased from 0.6 to 1.2 meters.

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DESIGN INFORMATION BULLETIN NUMBER 79-02

California Department of Transportation
Division of Design
Office of Geometric Design Standards

DESIGN CRITERIA FOR RESURFACING, RESTORATION, AND REHABILITATION (RRR) AND CERTAIN SAFETY, STORM DAMAGE, PROTECTIVE BETTERMENT, AND OPERATIONAL IMPROVEMENT PROJECTS

APPROVED BY

DOLORES VALLS
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DIVISION OF DESIGN

July 10, 2003

FORWARD

This document supplements the highway design guidance and standards provided in the California Department of Transportation Highway Design Manual (HDM). The standards established herein are categorized in the same manner as defined in Chapter 80 of the HDM.

This document is not a textbook or a substitute for engineering knowledge, experience or judgment. Many of the instructions given herein are subject to amendment as conditions and experience may warrant. Special situations may call for variation from the procedures described, subject to the approval of the Division of Design, or such other approval as may be specifically called for.

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Section 1 - Application of Resurfacing, Restoration, and Rehabilitation (RRR) Criteria

1.1 Purpose and Definition of RRR

Chapter 9 of the Project Development Procedures Manual (PDPM) describes the project development process for RRR projects including the procedures for Safety Analysis. The purpose of RRR projects is to preserve and extend the service life of existing highways for a minimum of ten years and enhance highway safety. This Design Information Bulletin (DIB) focuses on geometric design criteria for RRR projects. The designer must always emphasize implementation of cost-effective safety improvements where practical. This DIB provides guidelines and criteria to assist in identifying appropriate safety upgrades on RRR projects. Where this DIB does not discuss a subject the Highway Design Manual (HDM) new construction criteria will apply.

RRR work is generally regarded as heavy, non-routine maintenance work designed to preserve and extend the roadway service life for at least ten years as well as upgrading to enhance safety where reasonable. It differs from new construction or reconstruction in that it does not contemplate capacity improvements, major realignment or major upgrading of geometric features or standards. As described in Section 1.2, RRR criteria also apply to minor projects and certain other projects in addition to RRR projects. All project scopes and criteria must work within the context of the facility type where all modes of travel are considered.

Resurfacing generally consists of placing additional surface material such as asphalt concrete or portland cement concrete over a structurally sound highway or structure that needs treatment to extend its useful life.

Restoration means returning a road, structure, or collateral facility to the condition existing after original construction.

Rehabilitation implies providing some betterments, such as upgrading guardrail or widening shoulders.

1.2 Application of RRR Criteria

RRR criteria apply to geometric design features such as lane and shoulder widths, horizontal and vertical alignment, stopping sight distance, structure width, cross slope and superelevation, side slope, clear recovery zone, and intersections. They may also apply to such features as curb ramps, pavement edge drop, dike, curb and gutter, sidewalk, and drainage.

The RRR criteria in this DIB do not address such features as pavement section design, traffic control devices, pavement markings, roadway lighting, construction materials and methods.

Reconstruction projects (the fourth R) are generally required to meet new construction standards. Reconstruction features typically include the addition of lanes, and significant change to horizontal or vertical alignment of the highway. When reconstruction features exceed 50% of the project cost, it is considered a reconstruction project and is generally not eligible for State Highway Operation and Protection Program (SHOPP) funding.

Exceptions to nonstandard features are documented in a design exception fact sheet per HDM Index 82.2 and Chapter 21 of the PDPM unless the Headquarters Design Coordinator approves another means of documentation.

1.2.1 Two-Lane Conventional Highways

RRR criteria apply to all structure and roadway RRR projects on two lane conventional highways, three lane conventional highways not classified as multilane conventional highways.

RRR design criteria also apply to certain damage repair, protective betterment, operational improvements and safety-funded non-freeway projects as defined below:

- All projects costing less than the Minor A limit (excluding the cost of Right of Way and Environmental Mitigation).

- Projects costing more than the Minor A limit, not involving extensive grading, paving, or retaining structures that are not spot locations.

- Projects costing up to $2.5 million (including the cost of Right of Way and Environmental Mitigation) that are considered spot locations, up to approximately one kilometer in length. (Examples include: storm damage repair, curve improvements, adding turn pockets, misc. pavement widening, culvert replacement, and rock slope protection projects.) In some instances, projects with higher costs may use RRR criteria if approved by the Headquarters Design Coordinator.

- For the purpose of these design criteria, Permanent Restoration (PR) projects due to fire, earthquake, slides or storm damage that do not include structure work such as walls or bridges do not fall in the category of RRR design criteria and may be restored to the condition prior to the damage. If PR projects are adequately justified and approved by the Headquarters Design Coordinator and FHWA, they may be restored to RRR standards. All other damage repair projects are required to meet RRR criteria including structure work.

Capital Preventative Maintenance (CAPM) projects are not covered by this document. See the PDPM and Maintenance's CAPM Guidelines for information regarding CAPM projects.

1.2.2 Multilane Conventional Highways, Freeways, and Expressways

RRR projects on multilane conventional highways, freeways, and expressways are required to meet current geometric standards for new construction. In addition to the HDM, see Section 6 "Miscellaneous RRR Design Items for Freeways and Expressways" for other guidance.

1.3 References

Refer to the PDPM for procedures necessary to develop a Project Initiation Document (PID), which is a Project Scope Summary Report (PSSR) for RRR projects.

Additional information regarding highway design for RRR projects can be found in Chapter 4, "Rural Highways," of AASHTO's "Highway Safety Design and Operations Guide," AASHTO's "Roadside Design Guide" - - the latest editions can be found at https://www.transportation.org/publications/bookstore.nsf/Home?OpenForm . Other references include: DIB 82 "Pedestrian Accessibility Guidelines for Highway Projects," Storm Water Quality Handbook "Project Planning and Design Guide," the Headquarters Pavement Design website, and "Guidelines for Reconstruction of Intersections," August 1985, available through Headquarters Traffic Operations.

See “Main Streets: Flexibility in Design and Operations” publication located on the Division of Design’s “Context Sensitive Solutions” web site at http://www.dot.ca.gov/hq/oppd/context/index.htm for guidance on context sensitive solutions and traffic calming features.

Section 2 - Geometric Design on Two Lane Conventional Highways

2.1 Selection of Design Speed

The criteria for design speed discussed in HDM Index 101.1 apply to projects covered by DIB 79-02. The Headquarters Design Coordinator and/or Design Reviewer should be consulted regarding the design speed, and the design speed should be documented in the PSSR, Project Study Report (PSR), or Project Report (PR).

2.2 Stopping Sight Distance at Grade Crests and Sags

The criteria for stopping sight distance at vertical curves in HDM Indexes 201.1, 201.4, and 201.5 apply to projects covered by DIB 79-02. Vertical alignments shall be evaluated for possible improvements at "spot" locations. The evaluation of vertical curves must consider Traffic Accident Surveillance and Analysis System (TASAS) collision data. This is not to imply that all vertical curves within a project's limits should be upgraded. Typically, unless the roadway is reconstructed for other reasons, crest vertical curves will be upgraded following an evaluation, which must include the most recent TASAS collision data. District Traffic should assist when performing this evaluation. Special attention should be given to crest vertical curves where the available sight distance corresponding to the design speed of the crest vertical curve is 30 km/h or more below the 85th percentile speed of the section of highway preceding the curve - - District Traffic can assist in estimating the 85^{th} percentile. Where this condition exists and the crest vertical curve could conceal highway features such as intersections, driveways, horizontal curves, narrow bridges, at-grade railroad crossings, etc., consideration must be given to reconstructing these vertical curves or removing such obstacles. If reconstruction is not an option, consider installing warning signs.

Sag vertical curves are rarely related to collisions because drivers have adequate sight distance during daylight hours, and are usually restricted by headlight limitations at night. If necessary, street lighting can be added to mitigate reduced stopping sight distance on sag vertical curves. Discussions should be held with District Electrical regarding the feasibility of lighting. Sag vertical curves can be slightly improved during overlays with little extra cost or impacts.

2.3 Superelevation

The criteria for superelevation contained in HDM Index 202.2 apply to projects covered by DIB 79-02. If nonstandard superelevation rates exist, they must be evaluated for possible improvement.

Superelevation improvements can often be attained inexpensively and with minimal impact on overlay projects, and should therefore be incorporated. Where as-built plans do not exist or no longer reflect the current conditions, a Digital Inclinometer (Smart Level) may be used to estimate the superelevation rate.

2.4 Horizontal Alignment

The criteria for horizontal alignment contained in HDM Index 201.6 and Topic 203 apply to projects covered by DIB 79-02. Horizontal alignments shall be evaluated for possible improvements at "spot" locations. The evaluation of horizontal curves must consider TASAS collision data. District Traffic should assist when performing this evaluation. Typically, nonstandard horizontal curves requiring additional right of way and/or resulting in environmental impacts are not upgraded without a TASAS collision evaluation to support the additional costs or impacts.

Where the radius of a curve is less than 90 m, with an interior angle greater than 60 degrees, consideration must be given to providing additional lane width to accommodate vehicle offtracking. See HDM Topic 404 and Index 504.3(b) for more information and widening criteria.

The alignment of a segment of highway may consist of a series of curves. The first curve in each series (particularly following a long tangent) must receive special attention such that, once the driver has safely passed through it, the change in alignment has prepared the driver for subsequent curves. The design speed of the first curve following a long tangent should be at least equal to the design speed of the preceding highway segment, which is usually consistent with a 15 km/hr maximum speed reduction from the preceding tangent to the first curve since drivers tend to travel at higher speeds on tangents. Special attention must be given to any curve within the series that has a significantly smaller radius. When improvements are considered at any of the curves, the effect on the series, particularly the adjacent curves must be evaluated. The purpose is to avoid "moving" a collision concentration from one curve to another in the series. See HDM Index 203.3 for additional information regarding alignment consistency.

Although individual horizontal and vertical curves may meet design criteria, their use in combination must be considered to avoid undesirable alignments. See HDM Index 204.6 and AASHTO's "A Policy on Geometric Design of Highways and Streets" for guidance of desirable and undesirable alignment combinations.

Where horizontal curves are being evaluated, consider the following:

- Reconstruction with a larger horizontal radius.
- Correction or improvement of superelevation.
- Widening the shoulders.
- Installing rumble strips.
- Widening lanes or providing a buffer for truck offtracking.
- Flattening fill slopes that are 1:4 or steeper on the inside and outside of a horizontal curve. For slopes between 1:3 and 1:4, check for adequate run out distance. See AASHTO "Roadside Design Guide" for methods of determining the run out distance.
- Installation of roadside barrier. See the Traffic Manual and discuss with District Traffic for guidance.
- Permanently removing vegetation or cutting back slopes to provide a sight bench where stopping sight distance at horizontal curves is reduced by vegetation growth or cut sections.
- Consult District Traffic or the Headquarters Traffic Liaison about adding signs, delineation, and/or markers to mitigate operational deficiencies.
- Add lighting.
- Move intersections outside of curve.

2.5 Intersections (Public and Private Connections) and Driveways

2.5.1 General

Road connections (both public and private) and driveways must be evaluated for possible improvements. The decision to improve intersections can often be made by observing vehicle, bicycle, and pedestrian movements during field visits.

RRR projects present an opportunity for driveway upgrades. Contact District Permits for possible issues with existing driveways that may be addressed.

To facilitate movements in and out of driveways and local streets, connections should be paved to the edge of right of way or far enough beyond the right of way line so that the rear drive wheels of longer vehicles can accelerate on a paved surface. This is to prevent vehicles wheels from spinning while attempting to enter the highway. It also serves to prevent rock and debris from collecting on the mainline shoulder, which can be a problem for bicycles and pedestrians.

HDM Topic 205, HDM Indexes 405.7, 405.8, and 405.9, and Section 3.3 of this DIB provide guidance on the design of public road intersections and driveways.

2.5.2 Corner Sight Distance

The Corner Sight Distance criteria in HDM Topic 405 apply to projects covered by DIB 79-02. All intersections shall be evaluated for possible improvements. The evaluation of corner sight distance must consider TASAS collision data. District Traffic should assist when performing this evaluation. It is often difficult to obtain corner sight distance per HDM Topic 405 at all intersections, but that does not preclude the need to evaluate cost effective solutions at each location.

2.5.3 Left & Right Turn Channelization

Left and/or right turn channelization should be considered at intersections to public roads and other potential higher volume intersections.

Consult District Traffic Operations and Traffic Safety when establishing the need for turn channelization. See HDM Indexes 405.2 and 405.3 for geometric guidance on right and left turn channelization. Also see “Guidelines for Reconstruction of Intersections,” August 1985, available through Headquarters Traffic Operations.

2.5.4 Skew Angle

The criteria pertaining to Intersection Skew in HDM Index 403.3 apply to projects covered by DIB 79-02. Angles less than 75 degrees must be investigated for potential upgrades. Typically, skewed through streets will not be modified due to the large expense and right of way impacts associated with realigning the local street.

Skewed Tee intersections are typically more reasonable to upgrade than through streets because they impact only one side of the highway. Small radius curves are possible on the cross street because speeds on the cross street will be low due to the stopped condition. When Tee intersections cannot be upgraded without extensive realignments, improvements may be accomplished by minor widening at the curb returns and the striping realigned to an angle closer to perpendicular - - see 2.05(e) in this document for issues related to pedestrian movements when

increasing curb return radii. See HDM Index 403.3 for additional discussion on the angle of intersections.

2.5.5 Truck Turning

The criteria for truck turning in HDM Index 404.3 (2) and (3) apply to projects covered by DIB 79-02. Intersections experiencing frequent truck use should be evaluated to accommodate truck offtracking. See HDM Topic 404 and HDM Index 405.8 for information on designing for offtracking. Designers should inspect the ground adjacent to intersection curb returns for physical evidence of vehicle offtracking, which can identify those locations most in need of upgrades.

It is often impractical to provide for truck turning on most local streets due to the infrequency of truck use at these locations. Where truck volumes are very low, bus turning may be a more appropriate application, especially if it is a school bus or transit route. There are several factors affecting the decision to increase the curb return radii at these locations:

- Assure trucks and buses will off-track into same direction lanes and shoulders of the receiving roadway and not intrude on opposite direction lanes.
- Acceptability of increasing the distance of pedestrian crossings and impacts to wheelchair ramps - - see DIB 82 for more information on Americans with Disabilities Act (ADA) issues.
- Impacts to adjacent property and right of way cost.
- Pedestrian crossings become longer.
- Pedestrians waiting to cross are set further from turning vehicles, which might place pedestrians out of driver's field of vision.
- Large curb return radii could promote higher than desirable speeds for motor vehicles making right turn moves.

Section 3 - Geometric Cross Section for Two & Three Lane Conventional Highways

3.1 Widths

3.1.1 Traveled Way

All lane widths for projects covered by DIB 79-02 shall be 3.6 m except as follows: In urbanized areas with restricted right of way and operating speeds 60 km/h or less, it may be appropriate to reduce right and left turn pocket lane widths to 3.3 m when supported by an approved design exception. The lower speeds in the left and right turn lanes make it reasonable to use narrower widths in urban areas. As an order of importance, the right turn lane is typically reduced first because the left turn lane is adjacent to oncoming traffic. Truck turning can be an important factor when reducing lane widths under these conditions. A truck usage study and turning analysis must be applied to each location where turning lane widths are reduced.

Further reductions in right turn lane width to 3.0 m are sometimes warranted in severely constrained situations.

See DIB 79-02 Section 2.4 regarding lane widening for truck offtracking on radii less than 90 meters.

3.1.2 Shoulders

3.1.2.1 Roadbed

The shoulder widths given in Table 3.1 shall be the minimum paved shoulder width for two-lane conventional highway projects covered by DIB 79-02. Shoulders less than the "Minimum Existing In-Place Shoulder Width" shall be widened to the "RRR Shoulder Width." Shoulders at or above the "Minimum Existing In-Place Shoulder Width" may be rehabilitated at their existing widths, including minor widening for lateral support or uniformity of pavement width, **unless pavement widening or realignment is performed, then the RRR shoulder width criteria applies. If a safety analysis recommends widening beyond the "Minimum Existing In-Place Shoulder Width," the roadbed shall be widened to the "RRR Shoulder Width" or the "RRR Bridge Shoulder Width,"** as appropriate.

The evaluation of shoulder widths must consider TASAS collision data while placing emphasis on run-off-the-road type accidents. District Traffic should assist when performing this evaluation.

Shoulders are important to accommodate bicycle traffic, and pedestrian traffic where sidewalks are not present. The minimum usable shoulder for bicycles and pedestrians is 1.2 m, but wider shoulders are more appropriate. Wider shoulders should be considered on highways with higher vehicular volumes and speeds.

Truck, bus and recreational vehicle usage on a highway should be considered when determining shoulder widths. When truck, bus and/or recreational vehicle volumes are generally higher than 10%, particularly on curvilinear highways, shoulder widths greater than those in Table 3.1 should be considered.

When adding passing or climbing lanes or right turn lanes, the minimum width of the adjacent shoulder shall be 1.2 m.

Where a left turn lane is provided and a right turn lane is not, the right shoulder width shall be the "RRR shoulder width" as provided in Table 3.1, but not less than 1.2 m (1.5 m where a gutter is present). The minimum right shoulder width adjacent to right turn pockets shall be 1.2 m (1.5 m where a gutter is present).

3.1.2.2 Bridges

The bridge shoulder widths given in Table 3.1 shall be the minimum paved bridge shoulder for two-lane conventional highway projects covered by DIB 79-02. The structure clear width (width between curbs or rails, whichever is less) shall equal or exceed the approach roadbed width. Shoulders less than the "Minimum Existing In-Place Bridge Shoulder Width" shall be widened to the "RRR Bridge Shoulder Width." Bridge shoulders at or above the "Minimum Existing In-Place Bridge Shoulder Width" may be rehabilitated at their existing widths.

Upgrading existing bridge rail, approach guardrail, and guardrail connections are included regardless of the bridge shoulder width requirements discussed above. **If bridge rail is being replaced, the shoulders shall be widened to the bridge RRR shoulder width.** The Headquarters Bridge Preservation Program Manager must be consulted in determining if a bridge rail type requires upgrading.

Bridge replacement strategies shall meet new construction standards.

Table 3.1
Two-Lane Conventional Highway RRR Standards for Shoulder Widths

Existing ADT (vehicles)	RRR Bridge Shoulder Width (m)	RRR Shoulder Width (m)	Min. Existing In-Place Bridge Shoulder Width (m)	Min. Existing In-Place Shoulder Width (m)
0-250	1.2	0	0	0
251-1000	1.2	0.6	0.6	0
1001-3000	2.4	1.2	1.2	0.6
3001-6000	2.4	2.4	1.8	1.2
6001-18,000	2.4	2.4	2.4	1.2
Over 18,000	2.4	2.4	2.4	2.4

3.2 Cross Slopes

3.2.1 Traveled Way

The criteria in HDM Index 301.2 apply to projects covered by DIB 79-02.

3.2.2 Shoulders

The shoulder cross-slope criteria contained in HDM Indexes 302.2 and 307.2 also apply to projects covered by DIB 79-02, except as follows: **On tangent sections of conventional urban highways with operating speeds of less than 75 km/h and where it is necessary to match existing curb and gutter, the maximum shoulder cross slope shall be 8% except when snow and ice conditions prevail.**

When shoulder widths are 0.6 m or less, shoulder cross slopes shall match the traveled way cross slope, but may be increased to 9% if necessary for drainage.

When curb ramps are present, shoulder cross slopes greater than 5% may exceed ADA standards where the maximum grade break at the base of the curb ramp is 13.3%. See DIB 82 for more information regarding ADA requirements.

Where shoulder cross slopes do not meet the above criteria and it is not reasonable to adjust existing curb, gutter and sidewalk, grinding or removal and replacement of the pavement may be necessary. Each project must be evaluated on an individual basis. Where shoulders carry roadway drainage, the hydraulic capacity should be verified.

See HDM Indexes 301.2 and 302.2 for maximum grade break between edge of traveled way and shoulder cross slopes.

3.3 Curb and Dike

Curb and dike placement, removal, and replacement are all strategies used on projects covered by this document. Curbs and dikes have specific safety considerations and must be evaluated based upon HDM Topic 303. Current practice involves placing or replacing curb and dike only when necessary and after all safety aspects have been considered. Nonstandard curb and dike should be removed or replaced based on the guidance in HDM Topic 303 unless specific circumstances dictate otherwise. Dike removal should be reviewed by District Hydraulics and Maintenance.

3.4 Pedestrian and Americans with Disabilities Act (ADA) Requirements

The need for upgrades is decided on a project-by-project basis in accordance with DIB 82 and HDM Topic 105. Upgrades and additions to pedestrian facilities must be considered on projects covered by this document. Federal and State laws require the installation of curb ramps at intersections with curbs where they are absent. Pedestrian facilities that are altered must be upgraded to current ADA accessibility standards. If the project does not alter pedestrian facilities, consideration should still be given to upgrading. Although new sidewalks should be considered, projects covered by this document are not intended to add new pedestrian facilities throughout the limits of every project. Upgrades include such items as walkway (sidewalk) gap closures, widening to current standards, upgrading curb ramps to current standards, relocating path width obstructions, sidewalk cross slope, and accessible driveways. Consideration may be given to upgrading the existing sidewalks or constructing new ones as needed. Where pedestrians will use the shoulder in locations where sidewalks are not justified, see Section 3.2 of this DIB. School zones, rail grade crossings, parks, playgrounds, and other uses that have the potential to generate pedestrian activity may receive special attention. These upgrades are to be included in urban and suburban area projects unless justified otherwise per DIB 82. Upgrades should also be considered where safety deficiencies have been identified. ADA policy is continually changing, discussions should be held with the HQ Design Reviewer.

Section 4 - Clear Recovery Zone, Side Slopes, Horizontal Clearances, and Vertical Clearances

4.1 Clear Recovery Zone (CRZ)

The horizontal clearance criteria in HDM Index 309.1 apply to projects covered by DIB 79-02 with the exception of the following: It is not the intent to flatten all of the side slopes within the project limits. Typically, existing side slopes are not flattened unless the project incorporates grading on a slope, or there are CRZ concerns per an evaluation that considers TASAS collision data. District Traffic should assist when performing this evaluation. When widening or modifying existing embankment slopes, 1:4 or flatter side slopes should be used. Although cut slopes represent a form of fixed object and should also be 1:4 or flatter, less emphasis is placed on them. In any case, slopes should be designed as flat as is reasonable. Slopes steeper than 1:4 may require special erosion control features as described in the Storm Water Quality Handbook, "Project Planning and Design Guide" (PPDG). See HDM Topic 304 and Chapter 7 in the Traffic Manual for guidance on side slopes and their relation to the CRZ and placement of roadside barriers at the top of embankment slopes.

Evaluation of the CRZ must consider TASAS collision data. However, the absence of collisions should not be used as a reason to remove CRZ strategies from a project scope. Improving the CRZ is an effective proactive measure along corridors. District Traffic should assist when performing this evaluation.

The AASHTO publication "Roadside Design Guide" provides detailed design guidance for creating a forgiving roadside environment. Also, see Chapter 7 of the Traffic Manual.

4.2 Side Slopes

For projects covered by this document, the following standard from HDM Topic 304 is permissive: In projects involving grading where slopes catch in a distance less than 5.5 m from the edge of the shoulder, a uniform catch point, at least 5.5 m from the edge of the shoulder, should be used. This is done not only to improve errant vehicle recovery and aesthetics, but also to promote the use of large production grading equipment, which can reduce grading costs.

4.3 Vertical Clearance at Structures

Grade separation structures are not common on two-lane conventional highways; if encountered, the criteria in HDM Index 309.2 apply to projects covered by DIB 79-02. Reconstruction or raising the structure, and lowering the roadway are possible remedies that could be considered when evaluating solutions to increase vertical clearance. If it is decided to increase the vertical clearance, future overlays as well as any overlays incorporated in the current project should be considered.

Contact the Transportation Permits Region Manager to determine the potential use of the facility by over-height and over-width permit vehicles. The Office of Structure Design Liaison Engineer also needs to be contacted to discuss the Structures Replacement And Improvement Needs (STRAIN) Reports and any proposed improvements to the structure.

Section 5 - Miscellaneous Criteria for Two-Lane Conventional Highways, Multilane Conventional Highways, Freeways & Expressways

5.1 Pavement

Pavement rehabilitation strategies are constantly evolving with new technologies and materials. The following needs to be taken into account when selecting the RRR pavement strategy and new structural section design:

- Desired pavement service life
- Minimizing maintenance worker exposure
- Minimizing maintenance effort
- Consistency with adjacent corridor pavement
- Long term corridor plan
- Constructability
- Traffic handling during construction
- Cost effective (initial and life cycle)

Pavement repair techniques and rehabilitation strategies are to be developed in coordination with District Materials, District Maintenance, and the Office of Pavement Rehabilitation in METS. Refer to HDM Chapter 600 and Caltrans Pavement Guidance website (http://www.dot.ca.gov/hq/oppd/pavement/guidance.htm) for additional pavement information.

5.1.1 Pavement Edge Drop

Pavement edge drop (e.g., vertical drops or ruts) can develop at the edge of paved surfaces and must be investigated for safety concerns (see below for guidance). Unpaved driveways, public road intersections and private road intersections should be paved to prevent pavement edge drops from developing. Areas to be selectively paved are to be evaluated on a location-by-location basis.

Unless the project involves milling and replacing the same pavement thickness, consideration should be given to adding shoulder backing or reconstructing the embankment on overlay projects because edge drops often develop over time. See the Interim Pavement Tech Note on "Pavement Tapers" and the Pavement Tech Note on "Shoulder Backing" located in the Caltrans Pavement Guidance section of the pavement website (http://www.dot.ca.gov/hq/oppd/pavement/guidance.htm).

Longitudinal edge difference can be problematic for bicycles and motorcycles and should be avoided. On the outside of superelevation, overlays and surface treatments (including OGAC) must extend to the edge of shoulder. The criteria in HDM Index 1002.1 apply to projects covered by DIB 79-02 (Note: these standards apply to resurfacing such as overlays and digouts, not surface treatments such as OGAC or slurry seals).

5.1.2 Pavement Tapers

Pavement tapers are a common design detail for overlays and other RRR projects. The goal of tapers is to provide a smooth, ideally unnoticeable transition from one pavement type/overlay to another. Generic construction details and guidance has been prepared to assisted designers with pavement tapers. See "Guidance for Pavement Tapers" and "Guidance for the Application and Placement of Shoulder Backing" located in the Caltrans Pavement Guidance section of the pavement website (http://www.dot.ca.gov/hq/oppd/pavement/guidance.htm). This guidance

represents policies and procedures specific to only a few districts and should be tailored to meet the needs of each individual district.

5.1.3 Shoulder Backing

Shoulder backing is a common design item for paving projects. Shoulder backing is a thin course of granular material that is used to protect the outside edge of pavement from edge cracking, avoid pavement edge loss, provide edge support and minimize drop offs. Generic construction details and guidance has been prepared to assist designers with shoulder backing. See "Guidance for the Application and Placement of Shoulder Backing" located in the Caltrans Pavement Guidance of the pavement website (http://www.dot.ca.gov/hq/oppd/pavement/guidance.htm).

5.2 Upgrading Roadside Safety Devices

All non-NCHRP 350 (or the latest approved) safety devices should be considered for upgrade. Safety devices that may or may not meet NCHRP 350 typically include items such as Metal Beam Guard Rail (MBGR), guardrail end treatments, crash cushions, median barrier, bridge rail, and bridge approach rail, etc. Consult the District Traffic Safety Systems Coordinator regarding application and determination of the appropriate safety devices. These items must also be evaluated during the Safety Review.

Items such as MBGR, bridge rails, and barriers may require reconstruction when pavement, shoulder backing, or slope changes reducing or raise their heights below or above the required limits. Consult District Traffic regarding height requirements.

5.3 Signs and Delineation

All signs and pavement markings within the project limits should be evaluated for replacement and/or upgrading. The evaluation should consider visibility performance, conformance with existing policies, appearance and legibility for both day and night conditions.

While traffic control devices may not fully mitigate all problems associated with nonstandard geometric features, they can compensate for certain operational deficiencies. In addition, minimizing or eliminating possible adverse safety and operational features by judicious use of special traffic regulations, positive guidance techniques, and traffic operational improvements can often reduce extensive reconstruction of existing highways. District Traffic should be contacted for guidance when additional signs, markings, or other traffic control devices are being considered as a possible mitigation for a nonstandard geometric feature.

Signs with information regarding vertical clearance shall be updated or installed per Traffic Operations Policy Directive #00-03, effective 9/1/00. Interchange exit numbers shall be added per Traffic Operations Policy Directive #02-04, effective 2/1/02.

5.4 Structural (Bridge) Capacity

Existing structures within the project limits may have inadequate load capacity to meet the Transportation Permits Program needs. Consequently, the Transportation Permits Region Manager should be contacted to determine the potential use of the facility by overweight vehicles and the impacts of any load restricted bridges within the project limits. If a bridge is determined to require strengthening for loads, the bridge reconstruction work should normally be considered as a part of the project. Although strongly discouraged, under certain circumstances, structure reconstruction can be deferred to avoid delaying the project due to environmental and/or right of way clearance problems, structure design time constraints, etc. Guidelines regarding deferral of structure widening in the PDPM may also be applied to deferral of structure replacement.

5.5 Drainage Facilities

HDM Indexes 803.3 and 804.3 regarding the need for repair, replacement and upgrade of existing drainage facilities apply to projects covered by DIB 79-02. The local area maintenance supervisor should be contacted to assist in identifying drainage systems potentially in need of work or any known drainage problems that need to be corrected. District Materials should be contacted to check the culverts and determine the remaining service life and possible need for replacement.

Where shoulders carry roadway drainage, the hydraulic capacity should be verified. If the cross slope is modified, the designer should be aware that additional pavement thickness or cross slope modification may require modifying drainage facilities such as dikes, inlets, and slotted pipe.

Drainage features can present CRZ issues that should be considered for upgrade. Refer to the AASHTO Roadside Design Guide for design details related to traversable drainage features.

5.6 Compliance with the Storm Water Management Plan (SWMP)

Features required for compliance with the SWMP must be included in the project scope. This will not only involve Best Management Practices (BMP's) for work performed as part of strategies and upgrades, but may also include upgrades and improvements for existing deficiencies.

Contact the District Storm Water Coordinator for information on current requirements and suggested project work. Consult the District Maintenance Supervisor to ensure the proposed BMP's can be maintained in a cost effective manner.

5.7 Bicycle Considerations

Safety upgrades for bicycle usage must be taken into account on all projects covered by this document. It may be appropriate to widen shoulders or add bicycle lanes, particularly in urbanized areas. See HDM Index 1003.2 for bicycle lane widths when bicycle lanes are adjacent to on-street parallel vehicle parking to avoid conflicts between vehicle doors, bicycles and vehicles in the traveled way.

See HDM Chapter 1000 for bicycle usage design criteria including HDM Index 1003.6(2) regarding surface quality and the use of rumble strips, and HDM Index 1003.6(3) for requirements pertaining to drainage inlet grates. Also, see the Traffic publication "Evaluation of Milled-In Rumble Strips, Rolled-In Rumble Strips and Audible Edge Stripes" and Chapter 6 in the Traffic Manual for information on rumble strips.

5.8 Rumble Strips and Centerline Buffer Zones

Rumble strips may be an appropriate edge treatment adjacent to the outside lane of undivided highways, and both inside and outside lanes of divided facilities, particularly along those segments where collision data exhibits a high number of drift-off-road collisions. Consideration should also be given to adding a 0.5 to 1.0 m centerline buffer zone with rumble strips on highway segments where collision data exhibits a high number of cross centerline collisions. Cross centerline location information can be obtained from Headquarters Traffic Operation's "Two and Three Lane Report." Consult District Traffic regarding potential locations for rumble strips. See the Headquarters Traffic publication "Evaluation of Milled-In Rumble Strips, Rolled-In Rumble Strips and Audible Edge Stripes," Chapter 6 of the Traffic Manual, and Caltrans Standard Plans for information on rumble strips.

5.9 Highway Appurtenances

The necessity of adjusting miscellaneous highway appurtenances such as object markers, sign supports, luminaries, irrigation systems, etc., should be reviewed, particularly when there are potential or known maintenance safety issues. Although highway appurtenances will be studied during the Safety Review, they should be considered by all functional units, particularly Maintenance. See HDM Index 210.5 for information regarding safety railing, fences, and concrete barriers that may be appropriate work. Also, see DIB 79-02 Section 4.1, Clear Recovery Zone, for additional information.

Care should be taken to review the effects of existing and proposed highway appurtenances on all road users such as ADA accessibility, pedestrians, and bicyclists.

5.10 Maintenance

Contact the local area Maintenance Supervisor for consideration of highway deficiencies and safety upgrades. The local maintenance staff is very familiar with their segment of highway and can often identify highway upgrades or deficiencies that might otherwise be overlooked, such as drainage issues, pavement failures, collision locations, deficiencies in facilities used by non-motorized modes, slope stability problems, the need for maintenance pull-outs, safety issues, and other areas of concern.

Maintenance vehicle pull-outs should be placed upstream of recurrent work areas so the maintenance vehicle can shield the workers from errant vehicles. Similarly, it is appropriate to locate work areas downstream of large "fixed shields" such as structures, while keeping in mind sight distance for ingress/egress. The designer should look for opportunities to provide vehicle parking and access from adjacent parallel facilities (local roads) through use of gates and pathways. See HDM Index 107.2 for guidance on maintenance and law enforcement concerns.

5.11 Landscape

Although most projects covered under these guidelines do not require landscaping, there may be a need to replace existing landscaping due to construction. Consult District Landscape Architecture regarding the need for replacement.

Section 6 – Miscellaneous Criteria for Freeways and Expressways

6.1 Cross Slope (Traveled Way)

To achieve economies in materials and to minimize the impact on median facilities such as slotted drains, drainage inlets, and median barriers, it may be acceptable, however District Materials needs to be consulted, to reduce the thickness of the overlay on the inner lanes of the traveled way to the minimum thickness and cross-slope tolerances. The break or crown in resurfacing should be at the lane line and not in the wheel track.

On expressways, where the existing traveled way cross slopes exceed standards, and it is not reasonable to adjust existing curb, gutter, and sidewalk, milling or removal and replacement of the existing pavement may be necessary.

6.2 Ramps and Gore Areas

Consideration should be given to removing fixed objects in the vicinity of on-ramp and off-ramp gores. The need for removal or relocation of overhead signs, lighting, curbs, and existing crash cushions should be considered. A review should be made of the collision and maintenance history of "hits" into existing signs and crash cushions to determine the advisability of removing or relocating the signs and crash cushions. District Traffic and Maintenance should assist when performing this evaluation.

Gore curbs that are not in accordance with current policies should be removed from a design and cost standpoint - - see HDM Indexes 504.3(11) and 504.2(5), and Topic 303. When the overlay thickness matches or exceeds the height of curb, it may be unnecessary to remove the curb pending an investigation for the need to convey runoff.

When rehabilitating ramps on the National Network or on Service Terminal Access routes, consideration should be given to revising ramps to accommodate STAA design vehicles. Consult the District Truck Service Manager for routes that can easily be accessible on the National Network and Terminal Access routes. See HDM Indexes 404.3(2) and 404.3(3) for information regarding the use of truck-turn templates.

Consideration should be given to paving areas that will reduce maintenance worker's exposure to traffic and removing maintainable features such as inlets or controller cabinets ITS equipment, etc. See HDM Chapter 500 for guidance related to gore paving. Contact the local Maintenance office for assistance in determining these locations - - see Design Memo titled "New Design for Safety Practice: Roadside Paving" located on the Internet Website at: http://www.dot.ca.gov/hq/oppd/design/m093098.htm.

6.3 Vertical Clearance

Where existing vertical clearance does not meet the requirements stated in HDM Index 309.2(1)(b) and cannot be achieved by milling prior to overlaying the pavement, then removal and replacement of the existing pavement may be necessary. Removal of an existing overlay should always be considered to avoid reducing the vertical clearance. Raising the structure is another option that may be considered.

Regardless of the above criteria, Structures Maintenance must be contacted to determine the past history of structure hits.

When it is proposed to reduce the existing vertical clearance of a structure either temporarily or permanently, the Transportation Permits Region Manager must be contacted to determine the potential use of the roadway at the structure by over-height and over-width permit loads. If the route is part of the National Network, see HDM Index 309.2(3) for additional information regarding federal approval. The final decision should include consideration of adjacent structure clearances and the likelihood of over-height loads passing beneath the structure in question. Vertical clearance signs should be modified accordingly.

6.4 Interchange Spacing

Unless projects involve a new interchange or interchange relocation, there is no need for a design exception for interchange spacing as stated in HDM Index 501.3 and DIB 77. If projects do involve a new interchange or interchange relocation, HDM Index 501.3 and DIB 77 must be consulted.

Section 7 - Alternate Safety Measures

Highway design practice provides a broad range of alternative measures that can be used alone or in combination with others to improve the safety along existing highways. Much of the previous Sections in this DIB suggest reconstruction measures as a means for safety upgrades, but often reconstruction is impractical. The Office of Traffic Safety Program has additional guidance located on the Caltrans Intranet Website at http://issc.dot.ca.gov/trafops/otrafsaf/program/highwaysafetyi/Guidelin.htm which provides a list of "General Countermeasures for Accident Patterns and Their Probable Cause" that may aid designers; see 3.0 Accident Surveillance System, pages 3-15 through 3-21. To supplement the Highway Safety Improvement Program guidance, a partial list of alternative countermeasures to reconstruction for various existing geometric conditions are provided below:

EXISTING GEOMETRIC CONDITION	ALTERNATE COUNTERMEASURE
Narrow lanes and shoulders	Pavement edge lines Raised pavement markers Recessed pavement markers in snow areas Post (roadside) delineators Rumble strips Raised profile thermoplastic stripe
Steep side slopes	Shield with guardrail Roadside delineators
Roadside obstacles	Remove or relocate obstacle Slope flattening (including ditches) Add breakaway hardware to obstacle Shield with guardrail Delineate
Narrow bridge	Traffic control devices Approach guardrail Object markers Raised profile thermoplastic stripe striping
Poor sight distance at vertical crest	Traffic control devices Fixed-object removal Shoulder widening Relocate driveway or local road to a location with better sight distance Lighting
Sharp horizontal curve	Traffic control & warning devices Add lighting Shoulder widening Appropriate superelevation Slope flattening Pavement antiskid treatment Obstacle removal Obstacle shielding
Various Intersections Issues	Traffic control devices Traffic signalization (warrants must be met) Fixed lighting Speed controls Add turn lanes Increase sight distance